Lleidatech 2024 Book of Abstracts

- **Albert Solana, Mindsight Ventures:** ***Orchestrating Intelligence: Unleashing the Power of AI Multi-Agent Systems***

  In today's rapidly evolving technological landscape, the future of artificial intelligence lies not just in singular, powerful models, but in the symphony of multiple AI agents working in concert. At Mindsight Ventures, we're at the forefront of this revolution, architecting AI Multi-Agent Systems that are reshaping how businesses approach complex problem-solving and decision-making processes.
  This presentation will dive into the cutting-edge world of AI Multi-Agent Systems, exploring how we're leveraging this technology to accelerate business growth and drive innovation. We'll discuss:

  - The architecture of AI Multi-Agent Systems and how they differ from traditional AI approaches
  - Real-world applications and case studies demonstrating the transformative power of these systems
  - Strategies for integrating Multi-Agent Systems into existing business processes
  - The future of AI collaboration and its potential to revolutionize industries

- **Alexandre Llusera, MCSystems:** ***Integración de Datos en el Sector Primario: Decisiones Eficientes***

  La conferencia se centra en la integración de datos en el sector primario y la importancia de tomar decisiones fundamentadas. Se explica cómo el uso de sensores de nivel en silos permite monitorear en tiempo real los inventarios de materias primas, proporcionando datos precisos sobre el nivel de producto almacenado y su tasa de consumo. Esta información permite a las empresas gestionar compras de manera eficiente, anticipándose a las necesidades y evitando desabastecimientos. Además, con estos datos, es posible optimizar las rutas de entrega, mejorando la eficiencia operativa y reduciendo costos. En resumen, la integración de datos facilita un control más preciso del inventario, promoviendo decisiones informadas que hacen las operaciones más rentables y sostenibles.

- **Anas Al Rahamneh, Universidad Pública de Navarra:** ***Machine Learning-Based Predictive Maintenance System for Delivery Vehicles***

  The last-mile delivery segment faces several challenges, including optimal route planning, erratic delivery times, and vehicle maintenance, all of which significantly impact overall operational costs and customer satisfaction. Efficiently managing these challenges is crucial for improving service reliability and reducing costs. This work explores the application of TensorFlow Lite (TFLite) to address one of these critical issues by deploying machine learning models on mobile and edge devices.
  We propose a predictive maintenance system for delivery vehicles. Predictive maintenance leverages historical data and real-time sensor information to predict when maintenance is needed, thereby preventing total breakdowns and unscheduled downtimes. This proactive approach contrasts with traditional reactive maintenance, which often leads to higher costs and operational disruptions.
  Our system employs advanced machine learning algorithms to analyze patterns and

detect early signs of potential failures. The model is initially developed and trained on extensive datasets to ensure high accuracy and reliability. Following this, the model undergoes refinement to optimize its performance for real-world applications. To enable real-time processing and accessibility, the refined model is converted to TensorFlow Lite (TFLite). This conversion allows the model to be executed on smartphones and in-car systems, which are more cost-effective and versatile compared to traditional server-based solutions. By leveraging TFLite, we ensure that the predictive maintenance system can operate efficiently on devices with limited computational resources, providing timely alerts and maintenance recommendations.
In summary, our approach enhances vehicle reliability and operational efficiency while improving customer satisfaction by minimizing delivery delays caused by vehicle breakdowns. The integration of TFLite for real-time processing represents a significant advancement in predictive maintenance for the logistics industry.

- **Bianca Padurean, SEMIC:** ***Laying the Foundation: How to Prepare an AI Lab for Cutting-Edge Research***

  An introduction to preparing an AI lab environment and key considerations for decision making.

- **Diego Reiriz Cores, Gradiant:** ***Gradiant en el sector agrifood: caso de éxito y propuesta de servicios actual***

  Presentación del proyecto Plataforma cloud de datos federados con capa de inteligencia artificial para la mejora genética y reproductiva del ovino lechero nacional. El objetivo de este proyecto es lograr una mejora en la reproducción y en la selección de machos y hembras a través de una capa de inteligencia artificial sobre el dato conectada con innovaciones en la mejora de la inseminación artificial. Asimismo, Gradiant ofrece en la actualidad un amplio catálogo de servicios para la evaluación y validación de soluciones de IA y robótica en condiciones reales. Estos servicios se ofrecen en el marco del proyecto Agrifood TEF, construido como una red de instalaciones físicas y digitales en toda Europa para maximizar el impacto de la digitalización en el sector agrícola.

- **Eduard J. Alvarez Palau, Universitat Oberta de Catalunya:** ***Road Pricing Strategies: analyzing scenarios of Eurovignette's implementation in Barcelona***

  This study examines the impact of congestion pricing mechanisms in Barcelona, aiming to address urban sustainability challenges. By analysing six different congestion pricing models—from daily to distance-based pricing—this research evaluates their effectiveness in reducing traffic congestion, lowering greenhouse gas emissions, and encouraging public transportation usage. This analysis seeks to contribute to the academic discourse on urban mobility by offering a comprehensive assessment of these strategies' potential to enhance urban environments. Employing robust simulation techniques and a comprehensive dataset, the study provides evidence that congestion pricing can significantly influence urban transport dynamics, beyond merely generating collection. It explores the practical considerations of implementing such policies, including economic implications and logistical challenges, to understand their feasibility and potential outcomes in real-world settings. The findings suggest that carefully selected and implemented

congestion pricing strategies can serve as crucial tools for promoting more sustainable and efficient urban ecosystems. This research invites policymakers, urban planners, and the academic community to engage in a deeper exploration of congestion pricing as a multifaceted approach to urban sustainability.

- **Eva Martin Fuentes, Universitat de Lleida:** ***AI-Driven Social Media Listening about Airbnb***

  This study delves into Airbnb's brand presence on TikTok by analyzing textual content in posts, and human audio in videos. This approach aims to decipher the brand narrative and gauge user engagement. In the dynamic realm of social media marketing, TikTok has emerged as a key platform in shaping brand perception. This research specifically concentrates on Airbnb's content, distinguishing between official narratives and user-generated content (UGC). Notably, themes of "Travel" dominate official posts, contrasting with "Real Estate" and "Business" in UGC. The methodology employed involves advanced data collection techniques, including web scraping for textual data and artificial intelligence for transcribing human audio to text. The findings reveal that UGC commands greater engagement and volume compared to Airbnb's own brand content, underscoring the increasing significance of user involvement in brand storytelling. An analysis of the study results is conducted using linguistic natural processing (LNP) for the sentiment base, and the vector space model for emotion analysis. Sentiment analysis reveals a predominance of the emotion "happiness" and a significant presence of "surprise" in the posts, both of which are critical for audience engagement. Moreover, the study indicates a high approval rate for Airbnb-related content, reflecting a positive reception of the brand. Additionally, the research observes that influencers, particularly nano influencers, have higher engagement rates, indicating that their authenticity and relatability appeal especially to Generation Z audiences. This study not only sheds light on the intricate relationship between brand narrative, user engagement, and sentiment on TikTok but also offers valuable insights into effective brand image construction and propagation in the digital era, highlighting the importance of diverse emotions in enhancing audience engagement.

- **Jordi Gené Mola, IRTA:** ***Crop Type Mapping with Sentinel-2 Satellite Imagery and Artificial Intelligence***

  In the context of climate change and the imperative to adopt sustainable agricultural practices, the availability of mapping crop types is crucial. These maps are pivotal in defining agricultural resource management strategies, such as optimizing water distribution in irrigation districts, and informing policy-making aimed at enhancing food security. This study proposes novel approaches for obtaining crop type maps of an irrigated area early in the growing season by training transformer encoder architectures with Sentinel-2 time series data throughout the year. Three training approaches were compared: a baseline with incremental learning (M01), a single trainable model with sparse current-year data (M02), and a single trainable model with sparse multi-year data (M03). The latter approach, leveraging spectral data from the prior year, significantly outperformed the others, particularly for early-season classification. At the beginning of the year, M03 reported an accuracy of about 70%, compared to the 40% accuracy reported by methods M01 and M02. However, from September onwards, all three methods showed a similar performance, achieving

approximately 80% of accuracy. Furthermore, the training strategy followed by M02 and M03 enabled the possibility to train a single model capable to infer crop types throughout the year, providing a significant advantage over incremental learning, which requires separate trained models for each inference period. Finally, the intra-class evaluation showed variable performance across crop types, being the underrepresented crop classes the most challenging. Based on this findings, future work should focus on improving classification for these underrepresented classes and integrating additional data sources to further enhance model accuracy and robustness.

- **Josep Maria Salvia Hornos, BonÀrea:** ***Constraint programming applied to minimizing switching on a binary sorter***

  bonArea controls the entirety of its internal logistics, from the production to the shop. In this case study we research an operational research problem on physical binary sorters. These sorters route boxes to their destination and can become a logistical bottleneck. We propose a constraint programming solution that reduces the switching time by 60% and improves the throughput of the system.

- **Marc Escoto, Universitat Politècnica de València:** ***An Agile Optimization Algorithm for the Non-Smooth Electric Vehicle Routing Problem with Delivery Flexibility***

  This paper analyzes a non-smooth and realistic version of the vehicle routing problem in which a fleet of electric vehicles is employed in last-mile delivery. In order to better balance the load of the daily distribution task across the different time periods, a penalty cost is applied to vehicles for greater flexibility in the delivery times. These penalty costs, together with the driving-range limitations of the electric batteries, introduce some non-smooth components in the objective function. Since real-life instances of this problem need to be solved in short computing times --as new requests might arrive at the depot until a few minutes before starting the working day--, an `agile' optimization algorithm is proposed as a solving approach. Computational experiments demonstrate the efficiency of our approach, illustrating its ability to produce high-quality solutions within practical time frames. This underscores the practical viability and robustness of our proposed algorithm in optimizing last-mile delivery operations using electric vehicles with delivery flexibility.

- **Nuria Nievas Viñals, Fundación Eurecat:** ***Deep Reinforcement Learning-Based Control in Industrial Settings***

  Industrial and manufacturing processes often rely on static configurations and default settings, which limit their adaptability to environmental changes despite significant advancements in artificial intelligence. In contrast, real-time process adaptation can greatly enhance control and decision-making in dynamic environments. Deep reinforcement learning emerges as a promising approach for autonomous control. However, training online reinforcement learning in industrial contexts poses critical safety concerns. To address this issue, we propose a strategy that employs a surrogate model to pre-train reinforcement learning algorithms before their deployment in real-world settings. A case study in press hardening demonstrates the effectiveness of this approach.

- **Ouijdan Hajjaj El Imrani, Universitat de Lleida:** ***An empirical comparison of machine learning-based classification methods to identify pest hotspots in fruit orchards***

  The codling moth (Cydia pomonella (L.)) is an important pest affecting apple orchards. Monitoring the flight of the codling moth is essential within an integrated pest management program, since the treatments carried out against larvae are based on the captures of adults in the monitoring traps. A single trap per plot is often used to monitor the pest, located in a random location within it, or a specific location given the experience from previous campaigns. However, this location is almost never based on any previous analysis of the spatio-temporal dynamics of the pest at plot level. The objective of the present work is to analyze the spatio-temporal pattern of the codling moth in a typical apple orchard to improve the pest management program. The study was carried out in a plot of apple trees in the municipality of Puigverd de Lleida (Lleida, Catalonia, NE Spain), where 18 traps were installed and geo-referenced according to a systematic spatial pattern that covered the plot area. The count of captures was weekly throughout the flight period of this pest (April-September). At the end of each flight generation, sampling of the damage level was performed. Variogram analysis and mapping were carried out using advanced geostatistical techniques. The results showed an aggregate distribution of the Cydia pomonella population at plot scale with certain spatio-temporal stability of areas of high and low incidence. So, pesticide treatments can be approached using variable rate doses, opening the opportunity to incorporate pest maps for better integrated management.

- **Veronika Tsertsvadze, Universitat Politècnica de València:** ***Using Data Analytics, Machine Learning, and KPIs for Urban Planning and Design***

  Worldwide initiatives aim to facilitate urban transitions toward climate neutralty objectives through diverse urban planning and design methodologies. This study focuses on the extraction of key performance indicators to guide policymakers and local authorities in achieving climate neutrality targets. Within this context, the study explores the utilization of data analytics, machine learning, and key performance indicators for informed decision-making in urban planning and design. The k-means clustering algorithm is used to cluster European countries, and principal component analysis ranks the influence of key performance indicators on the countries clustering. Additionally, the study demonstrates how data analytics tools and machine learning methods guide policymakers in urban planning and design.

- **Xabier Martin, Universitat Politècinca de València:** ***An Agile Optimization Algorithm for the Tourist Trip Design Problem with Type-Covering Constraints***

  The Tourist Trip Design Problem with Type-Covering Constraints (TTDP-TC) is a novel variant of the well-established Orienteering Problem (OP) designed to address the complex preferences of tourists planning multi-day trips. Unlike classical routing problems, which require visiting all points of interest (POIs), the TTDP-TC allows selective visitation based on perceived value, subject to a maximum travel time constraint. This variant introduces a type-covering requirement, ensuring that each trip includes at least one POI of every specified type, adding a layer of complexity to the optimization process. In this paper, an agile optimization algorithm to solve the TTDP-TC efficiently is proposed, which aims to maximize the total profit collected

from visited POIs while ensuring compliance with type-covering requirements and travel time limits. The algorithm's performance is validated through extensive computational experiments, demonstrating its ability to generate high-quality solutions within short computational times. To further validate the competitiveness of our approach, an exact method to compare the results of our approach is also implemented. The proposed approach showcases significant potential for practical applications in tourist decision support systems, offering a flexible and robust solution for planning enriched and diverse tourist experiences.